

# Circuit Constant Determination Method Rev.1.0\_00

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The S-8471 Series and the S-8474 Series are wireless power ICs.

The S-8471 Series is a receiver control IC (Receiver), and the S-8474 Series is a transmitter control IC (Transmitter).

This application note serves as technical documentation that describes the combined operation and characteristics of the S-8471 Series and S-8474 Series.

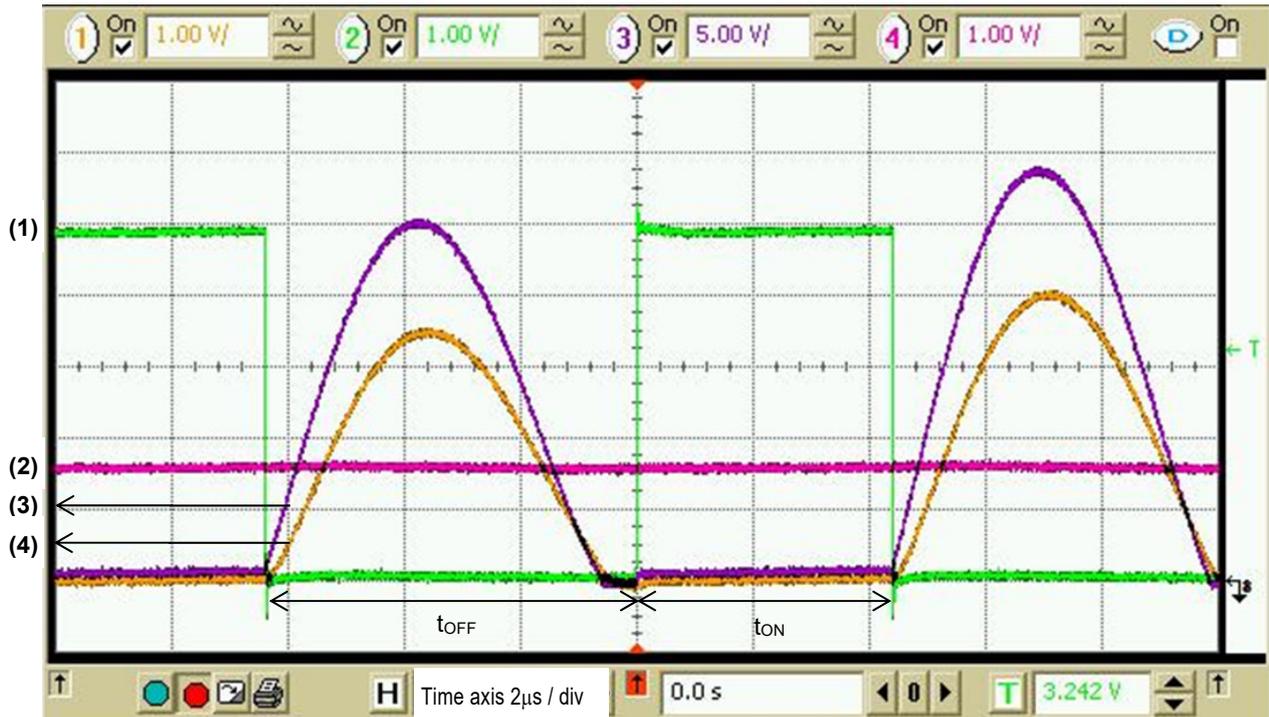
Refer to the S-8471 Series and S-8474 Series datasheets for additional details.

- Caution 1. Wireless power transfer devices which use the S-8471 Series and S-8474 Series are optimized to operate at LC resonant frequencies of approximately 88kHz to 106kHz. Within the 88kHz to 106kHz LC resonant frequency range, the circuit for detecting the receiver control IC operates, and the transmitter control IC also operates correctly. If the constants of the used coil (L) and capacitor (C) are changed, the LC resonant frequency also will change, so make sure to maintain the LC resonant frequency within the 88kHz to 106kHz range.**
- 2. There is polarity to the receiver coil and transmitter coil in wireless power transfer devices which use the S-8471 Series and S-8474 Series. Combine receiver coils and transmitter coils according to the details in this application note.**

## 2.5 Resonant frequency

As shown in **Figure 16**, the resonant frequency is determined by the inverse of the total time of  $t_{ON}$  time and  $t_{OFF}$  time of transmitter FET1. The resonant frequency is calculated with the following expression.

$$\text{Resonant frequency} = \frac{1}{t_{ON} + t_{OFF}}$$



- (1) OUT pin output (1V / div)
- (2) VS pin voltage (1V / div)
- (3) FET1 drain voltage at point C (5V / div)
- (4) LX pin voltage (1V / div)

**Figure 16 Actual Measured Waveform of Transmitter**

### 2.6 t<sub>ON</sub> time

t<sub>ON</sub> time refers to the time when the transmitter OUT pin remains "H" and FET1 is turned ON. t<sub>ON</sub> time is determined by the external resistor of the S-8474 Series (R<sub>TON</sub>). t<sub>ON</sub> time is calculated with the following expression.

$$t_{ON} [\mu s] \text{ typ.} = 3.86 \times R_{TON} [M\Omega] + 0.14$$

Since the optimum t<sub>ON</sub> time for the constant described in this application note is approximately 4.4μs, an R<sub>TON</sub> of 1.1MΩ is recommended. Variations of t<sub>ON</sub> time corresponding to R<sub>TON</sub> are shown in **Table 1**.

**Table 1**

R <sub>TON</sub>	t <sub>ON</sub> [μs]		
	Min.	Typ.	Max.
1.1MΩ*1	4.166	4.386	4.606

\*1. Recommended value

### 2.7 t<sub>OFF</sub> time

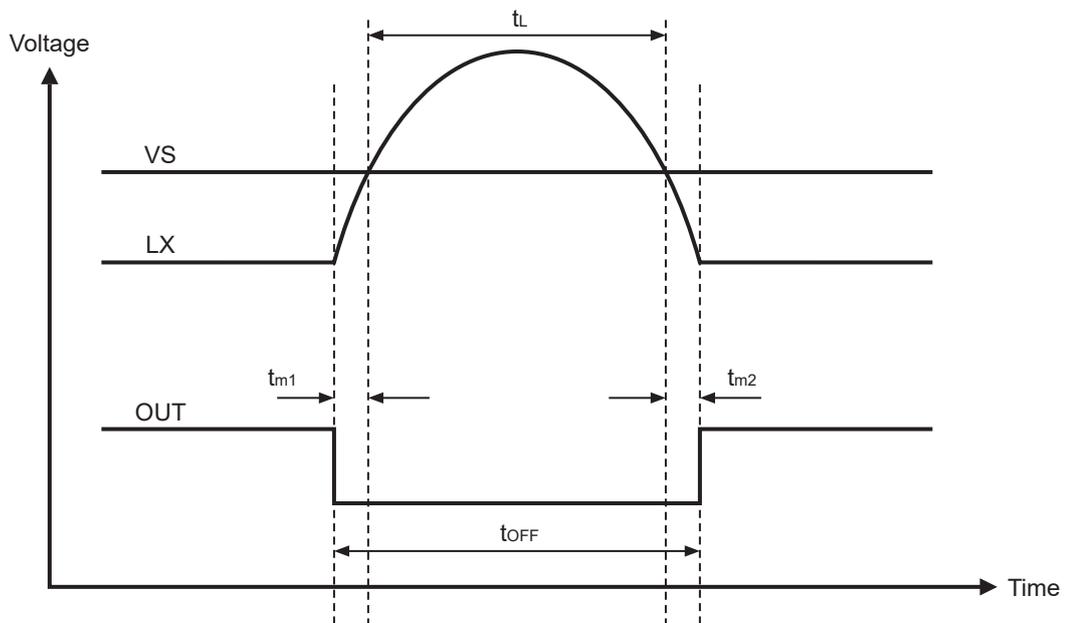
t<sub>OFF</sub> time refers to the time when the transmitter OUT pin remains "L" and FET1 is turned OFF. As shown in **Figure 17**, t<sub>OFF</sub> time is configured by t<sub>m1</sub> time, t<sub>L</sub> time and t<sub>m2</sub> time.

t<sub>m1</sub> time: The time period from when transmitter OUT pin output changes to "L" until the LX pin voltage exceeds the VS pin voltage

t<sub>L</sub> time: The time period from when LX pin voltage exceeds the VS pin voltage until it again falls below the VS pin voltage.

t<sub>m2</sub> time: The time period from when LX pin voltage falls below the VS pin voltage until the OUT pin changes to "H"

t<sub>m2</sub> time is generated in the IC to be nearly equivalent to t<sub>m1</sub> time. The OUT pin changes to "H" after t<sub>m2</sub> time has elapsed.

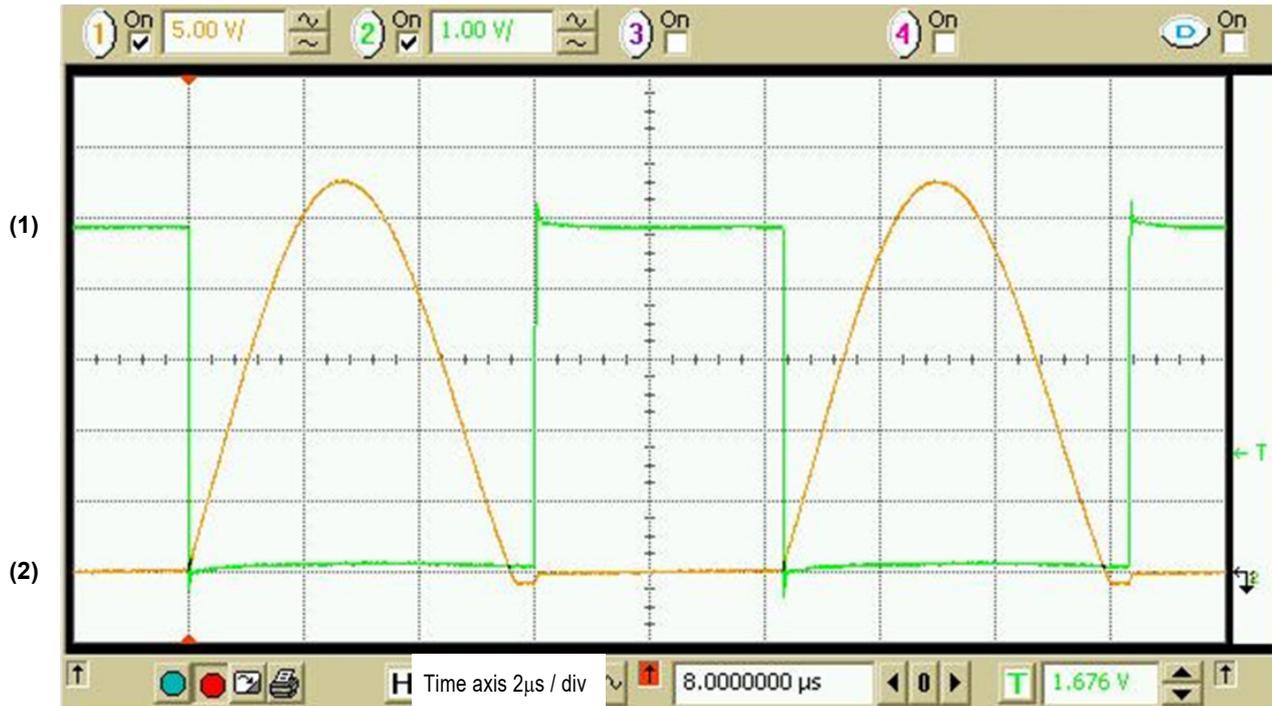


**Figure 17 Configuration of Transmitter t<sub>OFF</sub> Time**

## 2.8 Transmitter coil constant

Figure 18 shows each waveform of the transmitter. The values of external components (Refer to "Figure 27 Evaluation Measurement Circuit Diagram") used to achieve the transmitter resonant frequency of approximately 100kHz are as follows.

$$\begin{aligned} L1 &= 21\mu\text{H} \\ C1 &= 0.1\mu\text{F} \\ R_{\text{TON}} &= 1.1\text{M}\Omega \end{aligned}$$



- (1) Transmitter FET1 gate waveform (1V / div)  
 (2) Transmitter LC waveform at point C (5V / div)

Figure 18 Transmitter Waveforms

## 2.9 Receiver coil constant

The receiver LC resonant frequency is calculated with the following expression.

$$\text{LC resonant frequency} = \frac{1}{2\pi \times \sqrt{LC}}$$

Set the constant so that the receiver LC resonant frequency is nearly equivalent to the transmitter resonant frequency. The values of external components (Refer to "Figure 27 Evaluation Measurement Circuit Diagram") used to achieve a LC resonant frequency of approximately 100kHz (which is nearly equivalent to the transmitter resonant frequency) are as follows.

$$\begin{aligned} L2 &= 26\mu\text{H} \\ C2 &= 0.1\mu\text{F} \end{aligned}$$

## 4. Circuit Constant Determination Method

### 4.1 Over temperature protection function

#### 4.1.1 Basic operation

By connecting an external thermistor to the TH pin, a potential over temperature status (due to external component heat generation) can be prevented in the S-8471 Series and the S-8474 Series, respectively.

Connect the thermistor between the TH pin and the VSS pin. An NTC thermistor of  $R = 100\text{k}\Omega$  ( $R_{25}$ ) at  $T_a = +25^\circ\text{C}$  is recommended.

When the S-8471 Series over temperature protection function is in operation,  $V_{SS}$  is output from the OUT pin.

For example, if an NTC thermistor of  $R_{25}$  and  $B_{25/50}$  (B constant ( $25^\circ\text{C}/50^\circ\text{C}$ )) = 4250K is used, the over temperature protection function begins to operate at approximately  $+45^\circ\text{C}$ . When not using the over temperature protection function, set the TH pin open or connect a resistor of  $100\text{k}\Omega$  or greater.

When the S-8474 Series over temperature protection function is in operation, the OUT pin is latched to  $V_{SS}$ .

For example, if an NTC thermistor of  $R_{25}$  and  $B_{25/50}$  (B constant ( $25^\circ\text{C}/50^\circ\text{C}$ )) = 4250K is used, the over temperature protection function begins to operate at approximately  $+70^\circ\text{C}$  when  $V_{TSD} = 0.500\text{V}$ . When not using the over temperature protection function, set the TH pin open or connect a resistor of  $100\text{k}\Omega$  or greater.

The following describes how to exit the over temperature protection function in the S-8471 Series and the S-8474 Series.

#### (1) S-8471 Series

When external component heat generation decreases and the thermistor resistance increases to approximately  $15\text{k}\Omega$  typ. above  $R_{TH}$ , the over temperature protection function stops operating, and the IC returns to normal operation.

Also, when  $V_{DD}$  decreases to  $2.0\text{V}$  typ., the operation of the high temperature detection circuit is stopped and the IC returns to normal operation. The operation of the high temperature detection circuit is restarted when  $V_{DD}$  increases to  $2.1\text{V}$  typ. or higher.

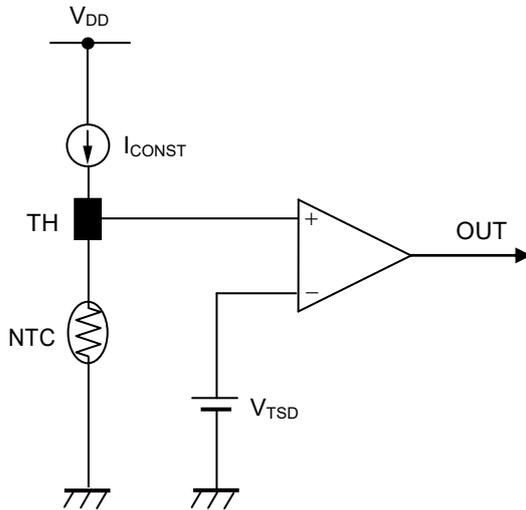
#### (2) S-8474 Series

When the over temperature protection function is in operation, the OUT pin is latched to  $V_{SS}$ . This latch cannot be released until the IC is reset.

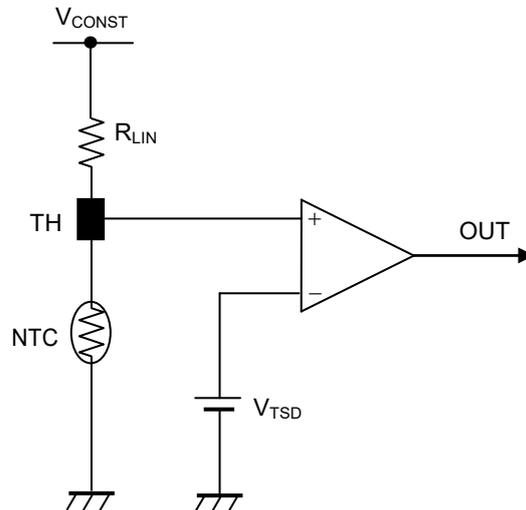
When  $V_{DD}$  decreases to  $4.1\text{V}$  typ. or lower, the UVLO function begins to operate, and the IC is reset. When  $V_{DD}$  increases to  $4.3\text{V}$  typ. or higher, the UVLO function stops operating, and the IC returns to normal operation.  $V_{SS}$  is output from the OUT pin during operation of the UVLO function.

#### 4. 1. 2 Operation principle of the high temperature detection circuit

The following figures show the basic principles of the high temperature detection circuits in the S-8471 Series and the S-8474 Series.



**Figure 28** Operation Diagram of Over Temperature Protection Function (S-8471 Series)



**Figure 29** Operation Diagram of Over Temperature Protection Function (S-8474 Series)

**Remark**  $I_{CONST}$ : Constant current source  
 $V_{CONST}$ : Constant voltage source  
 $R_{LIN}$ : TH pin internal resistance  
 $V_{TSD}$ : TH pin detection voltage (reference voltage)

Each constant is set as follows to calculate the over temperature protection function operating temperature.

**Table 3** S-8471 Series TH Pin Constant

Operation	$I_{CONST}$	$V_{TSD}$
Detection	10.0 $\mu$ A	0.410V
Release		0.560V

**Table 4** S-8474 Series TH Pin Constant

$R_{LIN}$	$V_{CONST}$	$V_{TSD}$ (Selectable)
61.00k $\Omega$	2.50V	0.667V
		0.577V
		0.500V
		0.429V
		0.370V

**4. 1. 3 Calculation of over temperature protection function operating temperature**

The following expression shows the relation between the NTC thermistor temperature and resistance.

$$R = R_0 \times \exp \left( B \times \left( \frac{1}{T} - \frac{1}{T_0} \right) \right)$$

**Remark** R: Resistance at ambient temperature T [K]  
 R<sub>0</sub>: Resistance at ambient temperature T<sub>0</sub> [K]  
 B: Thermistor constant

The NTC thermistor resistance varies according to ambient temperature change, resulting in change of the TH pin voltage. The over temperature protection function is controlled by comparing the TH pin voltage with the internal reference voltage in the IC.

The TH pin detection voltage (V<sub>TSD</sub>) in the S-8474 Series can be selected from the following five types. The over temperature protection function operating temperature changes in steps of approximately 5°C.

**Table 5 TH Pin Detection Voltage and Over Temperature Protection Function Operating Temperature of S-8474 Series**  
 B = 4250K

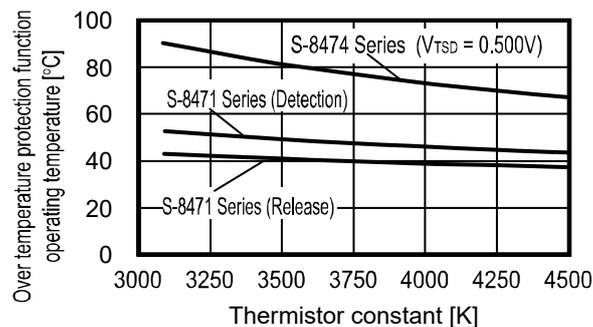
V <sub>TSD</sub> [V]	Over Temperature Protection Function Operating Temperature [°C]
0.667	60.2
0.577	65.3
0.500	70.3
0.429	75.6
0.370	80.7

The over temperature protection function operating temperature also changes by changing the thermistor constants. The following shows the over temperature protection function operating temperature change due to changes of thermistor constants.

**Table 6 Thermistor Constant and Over Temperature Protection Function Operating Temperature**

Thermistor Constant [K]	Over Temperature Protection Function Operating Temperature [°C]		
	S-8471 Series		S-8474 Series
	Detection	Release	V <sub>TSD</sub> = 0.500V
3100	53.0	42.6	90.8
3500	49.5	40.5	81.9
3950	46.5	38.6	74.3
4250*1	44.9	37.6	70.3
4500	43.7	36.9	67.4

\*1. Standard



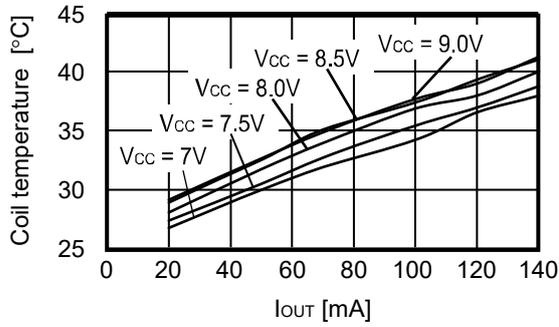
**Figure 30 Relation between Thermistor Constant and Over Temperature Protection Function Operating Temperature**



**(2) Coil temperature dependence**

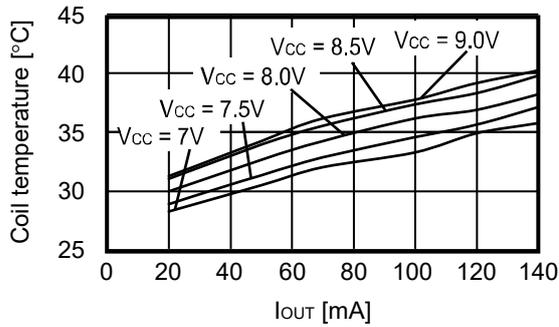
**(a) Receiver coil**

$V_{DD} = 5V$ ,  $T_a = +25^\circ C$ ,  $d = 3mm$ ,  $a = 0mm$



**(b) Transmitter coil**

$V_{DD} = 5V$ ,  $T_a = +25^\circ C$ ,  $d = 3mm$ ,  $a = 0mm$



**Remark** Measured in "Figure 27 Evaluation Measurement Circuit Diagram"  
 Transmitter coil: T6-0221-120L GOTO DENSHI CO., LTD.  
 Receiver coil: R4-0326-117L GOTO DENSHI CO., LTD.

4. 2. 4 Different operation mode and LED lighting status depending on load current

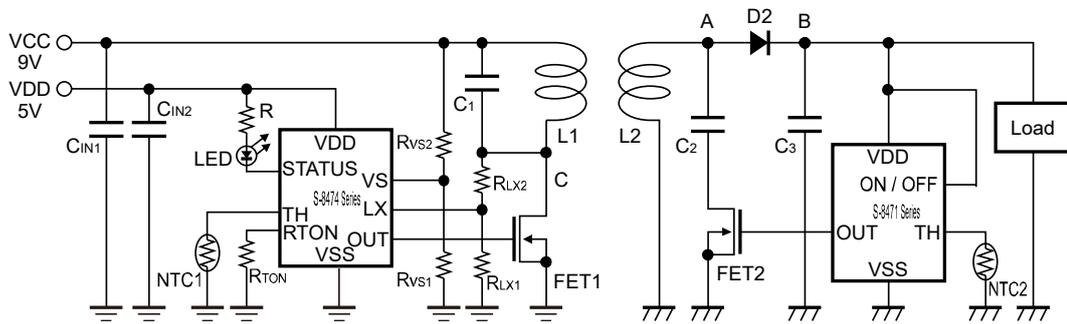


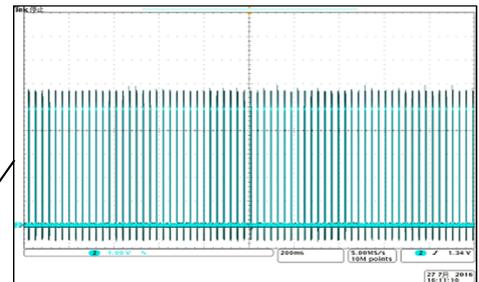
Figure 32

There are areas where intermittent operation mode and continuous operation mode are intermixed depending on load current (Refer to **Figure 33**). The lighting status of the LED connected to the STATUS pin in **Figure 32** is as follows in the areas where intermittent operation mode and continuous operation mode are intermixed. The LED is lit when the frequency of continuous operation mode is higher, and off when the frequency of intermittent operation mode is higher (Refer to "2. 1 Reception detection and operation mode of transmitter").

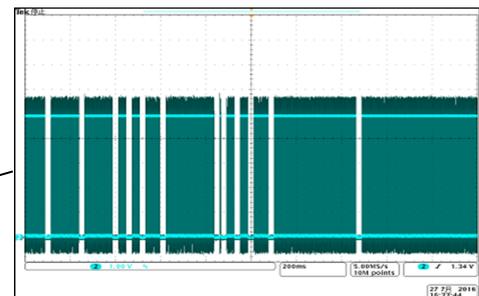
When load current is low and the mode is intermittent operation mode, it can be switched to continuous operation mode by setting a dummy load on the receiver to increase load current. In addition, when setting to intermittent operation mode during a halt of the receiver system, lower the idle load current until the operation mode of the transmitter switches to intermittent operation mode.

Load current (typ.) (mA)	Distance between coils 3mm	
	Operation mode	LED lighting status
0 to 0.7	Intermittent operation mode	Off
0.8 to 4.9	Mixed intermittent operation mode and continuous operation mode	Off or lit
5.0 or higher	Continuous operation mode	Lit

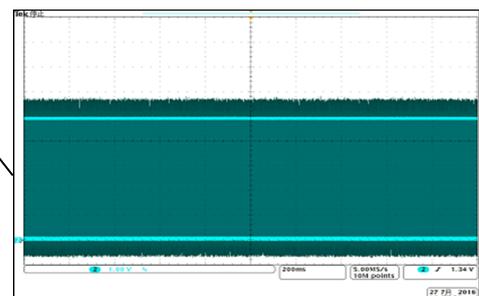
S-8474 Series OUT waveform



Intermittent operation mode continuation



Mixed intermittent operation mode and continuous operation mode



Continuous operation mode continuation

Figure 33

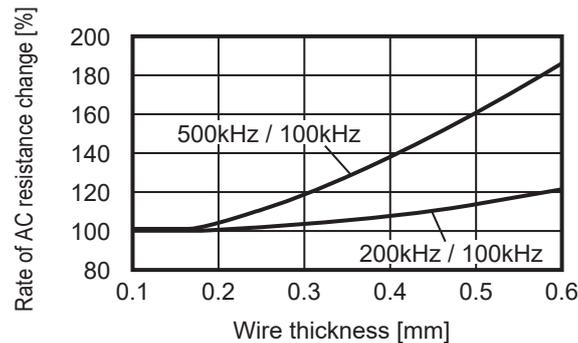
**Remark** Transmitter coil: T6-0221-120L GOTO DENSHI CO., LTD.  
Receiver coil: R4-0326-117L GOTO DENSHI CO., LTD.

### 4.3 Coils details

#### 4.3.1 Optimization of coil windings

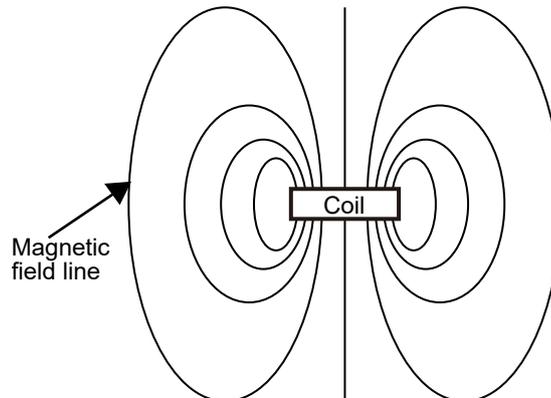
When using a wire with a length of 4m, measuring the rate of AC resistance while changing the frequency from the standard 100kHz to 200kHz and 500kHz, there will be a significant change of AC resistance with 0.15mm thick or larger wire. This phenomenon is known as the skin effect.

To reduce the skin effect, manufacture coils with stranded wires of 0.1mm to 0.15mm thickness.



**Figure 34 Coil Wire Thickness and Rate of AC Resistance Change**

#### 4.3.2 Changes in coil inductance due to metal objects near coils and heat generation



**Figure 35 Magnetic Field Lines Near Coils**

Alternating magnetic fields like the magnetic field lines shown in **Figure 35** occur near coils during power transfer. If metal objects are placed within this range, the coil inductance values will change as shown below.

- Nonmagnetic metals (aluminum, copper, etc.): Decrease
- Magnetic metals (iron, nickel): Increase

Changes in coil inductance value can cause the resonant frequency to deviate, which can in turn reduce efficiency and cause coils to generate heat. Install the coil in the product, and use a 100kHz frequency LCR meter to check if the inductance does not change.

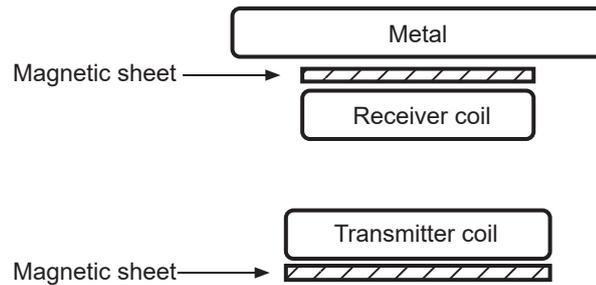
In addition, changes in magnetic field lines passing through metal can result in eddy current which can cause the metal itself to heat. Take the following measures to reduce the effect of magnetic field lines. Be particularly cautious when the GND pattern of printed circuits boards and the chassis are metallic.

- Move metal objects (aluminum, copper, etc.) as far away from coils as possible.
- Use magnetic shields when metal is placed near coils.

### 4.3.3 Magnetic sheets

If batteries and other metal objects are near the coils when power transfer is carried out by the receiver and transmitter coils, the system may be affected by magnetic fields and will generate heat. Placing magnetic sheets behind the coils as shielding can help reduce heat generation. It is recommended to increase the thickness of the magnetic sheet by 0.5mm if high heat is generated.

Heat generation can be further reduced by using ferrite cores as coil magnetic sheets to increase the Q value while improving thermal conductivity.



**Figure 36 Positioning of Magnetic Sheets**

#### 4.3.4 Coil selection (Standard coils for evaluation)

The following table lists specific transmitter and receiver coils that have been verified to operate with these wireless power ICs.

**Table 7 TDK Corporation Components List**

Applications	Components Name	Photo	Maximum Output Current	Outline	Height
Transmitter coil	WT202080-28F2-G		–	φ 20.0mm	2.74mm
Receiver coil	WR151580-48F2-G		100mA	φ 15.0mm	2.63mm

**Remark** TDK Corporation  
URL: <http://www.global.tdk.com/>

**Table 8 GOTO DENSHI CO., LTD. Components List**

Applications	Components Name	Photo	Maximum Output Current	Outline	Height
Transmitter coil	T6-0221-120L		–	φ 22mm	2.0mm
Receiver coil	R4-0326-117L		100mA	φ 14.5mm	1.6mm
Receiver coil	R4-0426-20S		33mA	φ 10mm	1.2mm

**Remark** GOTO DENSHI CO., LTD.  
734-1, Shibahashi, Sagae, Yamagata, 991-0063 Japan  
TEL: +81-237-84-2102 FAX: +81-237-84-2104  
URL: <http://www.goto-denshi.co.jp>  
Email: [info@goto-denshi.co.jp](mailto:info@goto-denshi.co.jp)

Table 9 TAIYO KOKI CO., LTD. Components List

Applications	Components Name	Photo	Maximum Output Current	Outline	Height
Transmitter coil	TWC21T20C05CF		–	φ 21mm	2.0mm
Receiver coil	TWC15T16C01CF		100mA	φ 15mm	1.6mm
Receiver coil	TWC10T14C01CF		33mA	φ 10mm	1.4mm

**Remark** TAIYO KOKI CO., LTD.

1-3-26, Kotobuki-cho, Fuchu-shi, Tokyo, 183-0056, Japan

TEL: +81-42-368-8181 FAX: +81-42-368-8182

URL: <http://www.taiyokoki.co.jp>

Email: [sales\\_nagasaki@taiyokoki.co.jp](mailto:sales_nagasaki@taiyokoki.co.jp)

#### 4. 3. 5 Coil recommended conditions and evaluation items

If not using standard coils, the user should carry out sufficient evaluation before use.

##### (1) Inductance

- Transmitter coil: 21 $\mu$ H, 100kHz
- Receiver coil: 26 $\mu$ H, 100kHz

If small coil sizes cause deviation from recommended inductance values, make a selection within the following ranges.

- Transmitter coil: 10 $\mu$ H to 21 $\mu$ H
- Receiver coil: 13 $\mu$ H to 26 $\mu$ H

If using a winding inductor for the receiver coil, radial type products with no shield are recommended. It is recommended to set the inductance ratio of the receiver coil and transmitter coil to approximately 0.81.

##### (2) Frequency

Frequency can be calculated as  $f = \frac{1}{2\pi \times \sqrt{LC}}$

Set the LC value so that the transmitter on its own is 110kHz and the receiver on its own is 99kHz. Make sure to check that the LC resonant frequency is operating at approximately 88kHz to 106kHz.

##### (3) DC resistance

A product with a low resistance value is recommended to suppress heat generation.

If load is 50mA or higher

- Transmitter coil: 0.3 $\Omega$  or lower
- Receiver coil: 0.5 $\Omega$  or lower

##### (4) Coil size

- Transmitter coil:  $\phi$  21mm, Receiver coil:  $\phi$  8mm to  $\phi$  10mm
- Transmitter coil:  $\phi$  16mm, Receiver coil:  $\phi$  3mm to  $\phi$  8mm

##### (5) Evaluation items

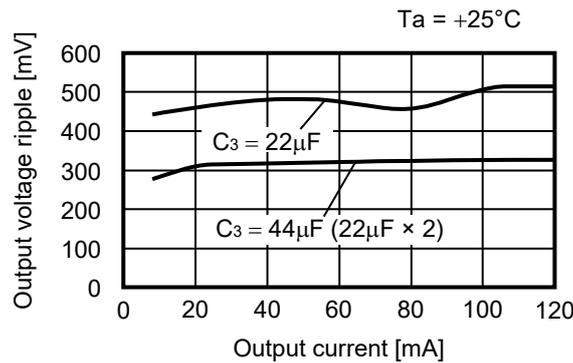
- Determine the range for distance between continuously operating coils while changing load.
- Measure coil temperature with heat generation while increasing load.

Deviating from recommended conditions will cause increased coil heat generation due to decreased efficiency. Improve air flow to dissipate heat.

## 4.4 Reception circuits

### 4.4.1 Smoothing capacitors

The receiver smoothing capacitor ( $C_3$ ) capacitance (Refer to "**Figure 27 Evaluation Measurement Circuit Diagram**") correlates with the output voltage ripple. Larger capacitance helps suppress output voltage ripple. However, if the capacitance is too large, the receiver VDD voltage may not reach  $V_{OVP}$  within the power reception detection time when transmission begins. This may prevent the transmission circuit from detecting the reception, resulting in the continuation of intermittent operation.



**Figure 37 Voltage Ripples of Different Output Capacitance**

### 4.4.2 Prevention of capacitor squealing

When ripple voltages are added to high dielectric constant ceramic capacitors of both the transmitter and receiver during cycles of audible ranges, mechanical vibrations transmit to the circuit boards, resulting in noise.

Ripple voltage in audible ranges are likely to be generated by the smoothing capacitors  $C_{IN1}$  of the transmitter (Refer to "**Figure 27 Evaluation Measurement Circuit Diagram**") and  $C_3$  of the receiver. To reduce capacitor squealing, replace capacitors with low dielectric constant ceramic capacitors or with tantalum capacitors.

### 4.4.3 Multiple receivers from 1 transmitter coil

Be careful of the following when multiple receiver coils receive power from 1 transmitter coil.

- Continuous operation continues if one receiver continues to fulfill the continuous operation conditions when the other receiver is at no load.
- The total value of receiver current received by multiple receivers should be within 100mA.

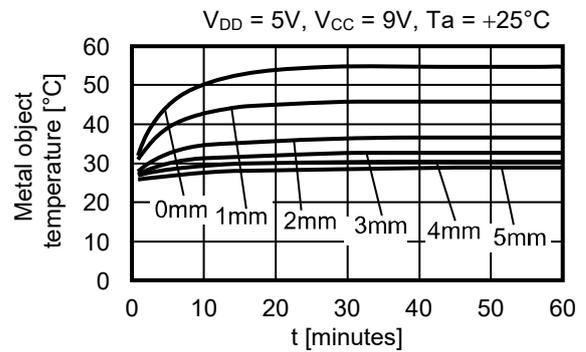
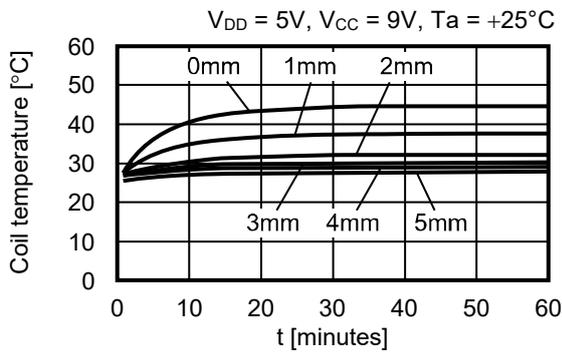
## 4.5 System safety

### 4.5.1 Safety measures for cases where a metal object is placed on the transmitter coil

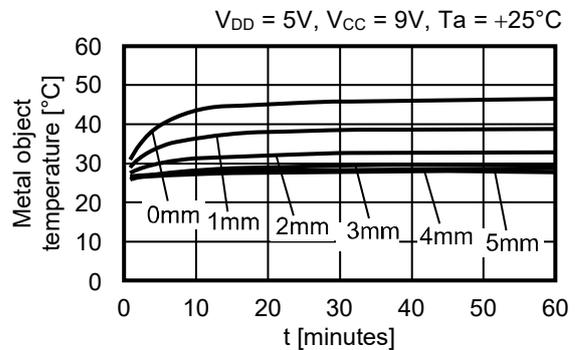
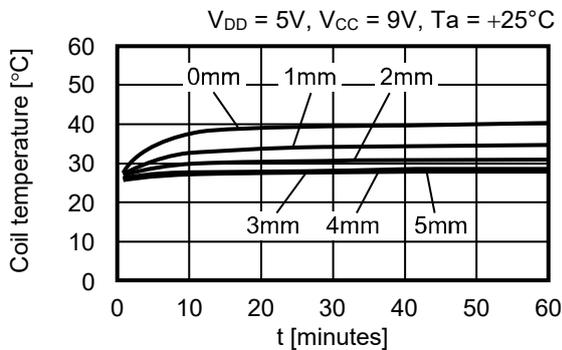
If there is no receiver coil and a metal object (100 yen coin, 1 yen coin, 1 yuan coin, etc.) is placed on top of the transmitter coil during intermittent operation, the closer the distance between the transmitter coil and the metal object, the higher the heat generation will be. Design the structure so that the distance between the transmitter coil and metal objects is 2mm or more, to reduce the effect of magnetic field lines. It can also be effective to design the structure so that the coil is placed perpendicularly to prevent objects from sitting on the coil.

Temperature increase data as a result of the distance (d) between metal objects and the transmitter coil is shown below.

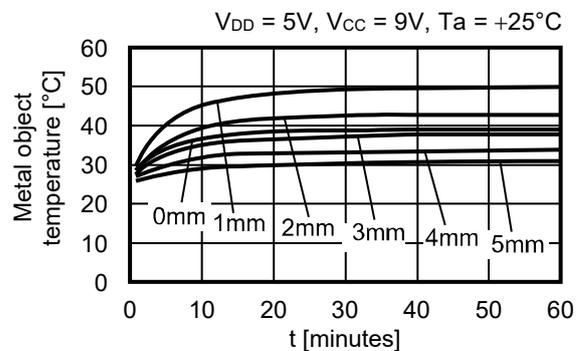
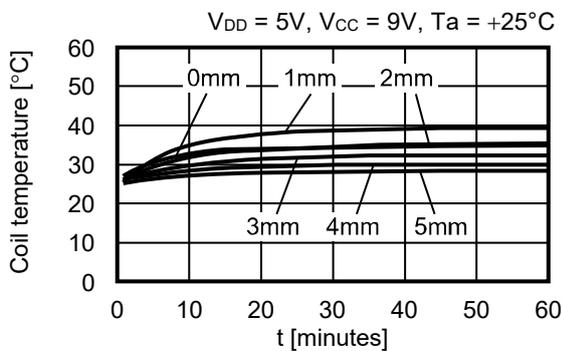
#### (1) Metal object: 100 yen coin



#### (2) Metal object: 1 yen coin



#### (3) Metal object: 1 yuan coin

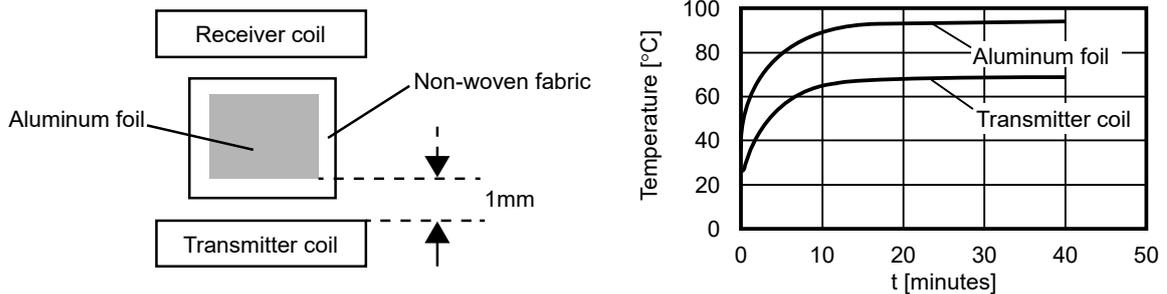


**Remark** Transmitter coil: T6-0221-120L GOTO DENSHI CO., LTD.  
Receiver coil: R4-0326-117L GOTO DENSHI CO., LTD.

**4. 5. 2 If a metal object becomes caught between coils**

If there is a receiver coil, and a metal object (approximately the size and thickness of a 100 yen coin) close to the size of the coil becomes caught between the transmitter coil and receiver coil during continuous operation, the metal object will absorb the magnetic field, causing operation to switch from continuous operation to intermittent operation.

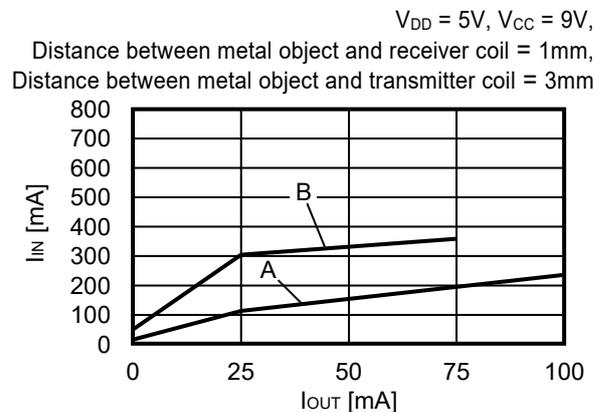
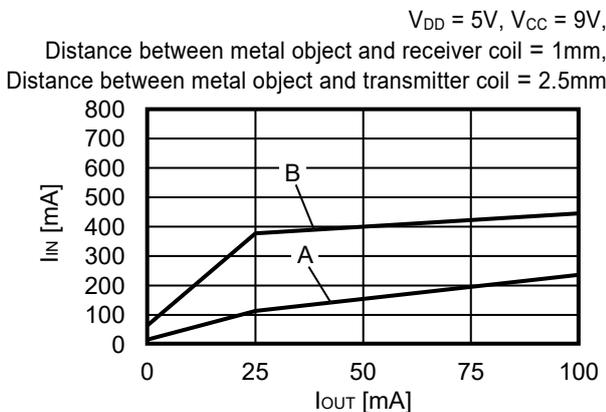
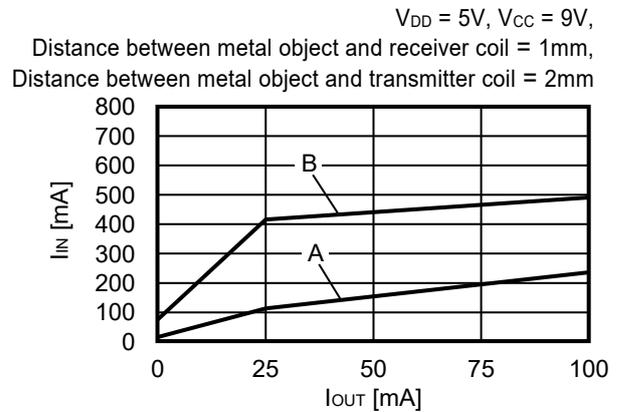
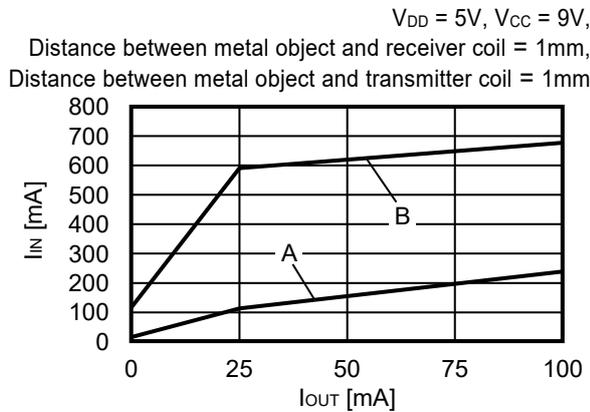
However, if a metal object which is easily penetrated by the magnetic field (aluminum foil, paperclip, etc.) becomes caught, continuous operation will be maintained. Changes in the magnetic field lines which pass through the metal object will cause eddy current, which will cause the metal object to generate heat, and the current which flows to the transmitter coil will increase, also causing the transmitter coil to generate heat. **Figure 38** shows the temperature increases of the aluminum foil and transmitter coil when a piece of aluminum foil is wrapped in high heat resistant non-woven fabric to suppress heat dissipation and placed at a distance of 1mm from the transmitter coil.



**Figure 38**

The input current ( $I_{IN}$ ) without (A) the metal object (aluminum foil) and with (B) the metal object (aluminum foil) is shown below.

When the metal object (aluminum foil  $\phi$  22mm) is caught between the coils, the current ( $I_{IN}$ ) which flows in the transmission circuit changes depending on the distance between the metal object and the transmitter coil.



**Remark** Measured with a circuit with the resettable fuse (F1) and thermistor (NTC1) from the transmission circuit in **Figure 39** removed.  
Transmitter coil: T6-0221-120L GOTO DENSHI CO., LTD.  
Receiver coil: R4-0326-117L GOTO DENSHI CO., LTD.

#### 4. 5. 3 Safety measures for cases where a metal object becomes caught between coils

- (1) Design so that the distance between metal objects and coils is 2mm or more. Also place the coil perpendicularly to prevent metal objects from sitting on the coil.
- (2) Add a resettable fuse. Refer to "**5. 1. 1 PPTC (Resettable fuse)**" for details.
- (3) Add a current limit circuit. Refer to "**5. 1. 2 Current limit circuit**" for details.
- (4) Connect an NTC thermistor to the TH pin of S-8474 Series to detect coil heating location temperature. The influence of extraneous signals can be reduced by connecting  $C_{NTC}$  (approximately 100pF to 1000pF) between the TH pin and GND. If the coil exceeds the detection temperature, the output of S-8474 Series will halt, and power transfer will halt. The power transfer halting status will be latched, so the power supply must be shut down and turned back on in order to restart operation.

#### 4. 5. 4 When using other companies' products for the receiver

The receiver detection mechanism of S-8474 Series detects the transmitter coil voltage changes to determine which operation mode to select from continuous operation or intermittent operation. For this reason, if there is a coil with electromagnetic induction on the receiver and a load is connected, the S-8474 Series may enter continuous operation mode. The following steps are recommended as countermeasures.

- Design so that the transmitter and receiver positions can be uniquely aligned.
- Use a Hall effect IC on the transmitter and a magnet on the receiver to align the positions.

## 6. Board Design Considerations

- When wiring a board, make a single GND as described in the S-8471 Series and the S-8474 Series datasheets.
- To protect from overheat, be sure to connect an NTC thermistor to the TH pin for its use.
- For VCC in **Figure 49**, do not use a power supply which might cause frequency component amplitude of 1kHz to 110kHz (LC resonant frequency). It may result in a malfunction.
- For VDD in **Figure 49**, do not use a power supply which might cause frequency component amplitude to prevent from malfunction.
- When designing the board in **Figure 49**, for the following reasons, do not place a wiring near the RTON pin, the VS pin, and the TH pin. Layout so that resistor  $R_{TON}$  is as close to the RTON pin as possible.

(1) Due to coil L1 and resonant capacitor ( $C_1$ ), large voltage fluctuation is generated at point C.

(2) Since impedance in the RTON pin, the VS pin, and the TH pin is high, they are easily affected by an extraneous signal.

By connecting  $C_{RTON}$  (approximately 100pF to 1000pF) between the RTON pin and GND,  $C_{VS}$  (approximately 100pF to 1000pF) between the VS pin and GND and  $C_{NTC}$  (approximately 100pF to 1000pF) between the TH pin and GND, the influence of extraneous signal can be reduced.

When detecting the coil temperature using an NTC thermistor in particular, the detection temperature may shift to the high temperature side as a result of the effect of the coil signal. It is recommended that  $C_{NTC}$  be connected between the TH pin and GND.

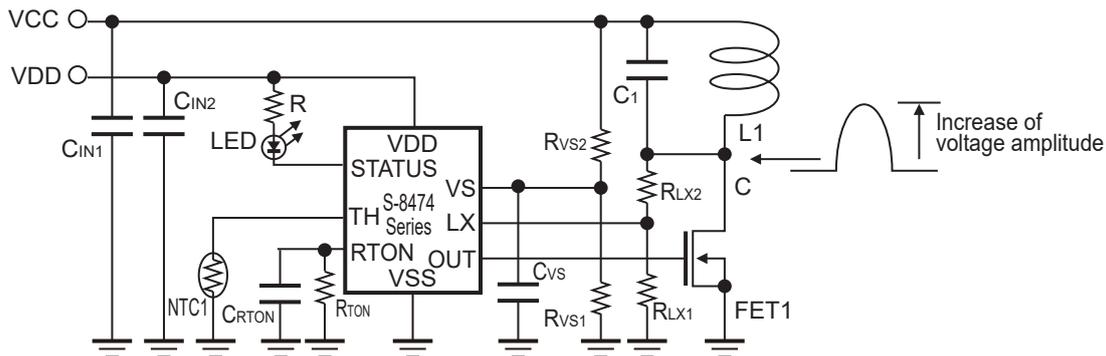


Figure 49

## 7. Precautions

- The usages described in this application note are typical examples using ABLIC Inc. ICs. Perform thorough evaluation before use.
- When designing for mass production using an application circuit described herein, the product deviation and temperature characteristics of the external components should be taken into consideration. ABLIC Inc. bears no responsibility for any patent infringements related to products using the circuits described herein.
- ABLIC Inc. claims no responsibility for any and all disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

## 8. Related Sources

Refer to the following datasheets for details of the S-8471 Series and the S-8474 Series.

**S-8471 Series Datasheet**

**S-8474 Series Datasheet**

The information described herein is subject to change without notice.

Please contact our sales representatives for information regarding the latest product version / revision.